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END BOOSTER FOR HEAT RESISTANT MILD DETONATING FUSE (U)

DDC

6 APRIL 1966

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UNITED STATES NAVAL ORDNANCE LABORATORY, WHITE OAK, MARYLAND

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END BOOSTER FOR HEAT RESISTANT MILD DETONATING FUSE (U)

By E. Eugene Kilmer

ABSTRACT: A heat resistant explosive system containing mild detonating fuse (MDF) and/or flexible linear shaped charge (FLSC) is not complete without an end booster to transfer detonation into and/or out of the system. Hexanitrostilbene, HNS-I, has the physical and explosive properties suitable for an end booster.

EXPLOSION DYNAMICS DIVISION
EXPLOSIONS RESEARCH DEPARTMENT
U. S. NAVAL ORDNANCE LABORATORY
WHITE OAK, MARYLAND

NOLTR 65-98 6 April 1966

END BOOSTER FOR HEAT RESISTANT MILD DETONATING FUSE (U)

This is one of the reports on "The Investigation of High and Low Temperature Resistant Explosive Devices" work being conducted for NASA, Manned Spacecraft Center at Houston, Texas under Task NOL-787. Related work leading up to this study was sponsored by the FBM Evaluation Committee of the U. S. Naval Ordnance Laboratory under assignment from the Special Projects Office, Bureau of Naval Weapons (References 1 through 4). This work is being carried out to investigate new heat resistant explosives and to determine their usefulness in explosive components for future space programs like APOLLO. This report discusses the design and testing of an end booster for heat resistant mild detonating fuse.

The identification of commercial materials implies no criticism or endorsement by the U. S. Naval Ordnance Laboratory.

J. A. DARE
Captain, USN
Commander

C. J. Aronson

C. J. ARONSON
By direction

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INTRODUCTION

Previous efforts have indicated a need in the NASA APOLLO program and the Navy, Air Force F-111 airplane for a mild detonating fuse (MDF) end booster[1-4]*. MDF must be capable of accepting detonation from an initiating device and transfering it to the next explosive component in the system. Therefore, a study has been undertaken to determine the requirements for a donor/acceptor type of end coupler/end booster** for MDF. This work was phased into a research task because of problems encountered by the Ensign-Bickford Co[5]. They found that a 2-grain/foot DIPAM-MDF would not reliably initiate a typical end booster loaded with DIPAM. See Figure 1. DIPAM was being used for its heat resistant characteristics. Successful detonation transfer from the MDF into the much larger diameter DIPAM end booster column could be effected in DIPAM only when it was pressed at the low pressures of 4 KPSI and 10 KPSI. At higher pressures transfer failure occurred.

It was suspected that the abrupt change in explosive diameter at the end booster/MDF interface was the most likely single source of difficulty. Studies were therefore undertaken to determine a reliable end booster design.

STUDY OF THE END COUPLER

The designs chosen for this study are shown in Figure 2. The designs embody a gradual transition from the very small column diameter in the MDF to a diameter comparable to the base charge of a standard, small-size service detonator or lead. Two conical transition sections were studied, one with a 20-degree included angle and the other with a 30-degree included angle. Expecting that there might be trouble initiating the heat-resistant explosive in the conical section (because they are all less shock-sensitive than PETN or RDX) it was decided to try the three heat resistant explosives, DIPAM, HNS, and NONA, in as many particle sizes as could be obtained. Photomicrographs of some of these explosives are shown in Figs. 3 through 8.

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*References may be found on page 7.

**The term "end coupler" refers to the explosive component in, attached, and integral with the end of a piece of MDF or FLSC which will either accept detonation from MDF or FLSC and emit a detonation wave, or else will accept a detonation from a source external to the device and transfer detonation into the MDF or FLSC. And end booster is an explosive component attached to the end coupler , opposite the MDF or FLSC, to augment the end coupler output.

After the MDF was fastened into the coupler body the charge was loaded into the end coupler in one increment. The loading pressure was varied to change the density and therefore the sensitivity of the end coupler charge. The test configurations (whether 20°- or 30°-cones) and test results with DIPAM, HNS, and NONA are shown in Figure 9. The results showed that pilot production DIPAM (Figure 4) was only marginally initiated, it could not sustain detonation when pressed below 64,000 psi. We hypothesize that this is in keeping with the observation that for most pure molecular high explosives the critical failure diameter decreases with increasing loading density. The loading and testing continued using smaller and larger particle sizes (Figures 3 and 5) with the possibility that their sensitivity to small shock intensities would be different. It is obvious from the results that these were not even as good as the standard pilot production DIPAM. Two approaches were considered: (a) use an even more gradual transition in the end coupler tapered section, and (b) use a more readily initiated explosive. We knew that, in general, HNS is more readily initiated by shock than DIPAM. However, we did not know how the density, particle size, and perhaps purity, of various types of HNS might affect initiability in this particular application.

When a 20° cone was used rather than a 30°-cone, there was no particular improvement in the performance of DIPAM. However, HNS-R* (Figure 6) showed better performance at lower loading pressures.

HNS-I (Figure 7) is inherently a much finer-grained material than HNS-R. Judging by output as a function of loading pressure (in the 20°-cone configuration) we see that HNS-R will probably not be reliable when loaded at 16,000 psi or less, while HNS-I would be reliable from 4,000 to 32,000 psi and, by extrapolation, at 64,000 psi. The fall-off of output with decreasing loading pressure (and therefore with lessening charge density) for HNS-I occurs simply because there just isn't as much explosive present in the low density charges. On the other hand, the sharp change in output for HNS-R between 32,000 and 16,000 psi cannot be explained solely by the density difference.

---

*We point out the two major types of HNS used:

(a) HNS-I[6,18] is produced by a one step reaction, using TNT as a starting material.

(b) HNS-R can be produced by recrystallizing HNS-I. Some of its properties are given in Reference 3. However, in Reference 3 it is referred to simply as "HNS".

The single test with NONA (Fig. 8) suggests that the material might work well in the end coupler application. Such a view is consistent with the fact that NONA is more sensitive than HNS-1 to shock and is not too greatly different in particle size. When NONA becomes more readily available it would be quite logical to explore more fully its use in this application.

The tests reported in Fig. 9 certainly are not a thorough study of the variables. There does appear to be a trend in favor of the 20°-cone over the 30°-cone perhaps because of the greater column length in which to build to a stable detonation process. However, there is no clear indication of choice between the two cone angles, particularly at the higher loading pressures. And, as will be seen later in this report, either design has sufficient explosive output to initiate the end booster.

STUDY OF THE END BOOSTER

Since the end coupler appeared to be acceptable (based on output dent data on aluminum plates) the next step was to test it with the next explosive component in the train — the end booster. Steel blocks were used to measure the output because the base charge of the end booster would be expected to be much more potent. The end-coupler loading pressure and taper were varied to determine their effect on end-booster base-charge performance. The results in Fig. 10 indicate that HNS-I should be an acceptable initiator for a DIPAM base charge.

A typical way of utilizing end boosters is to transfer detonation from one to another across a gap where the two are aligned end-to-end on a common centerline (flat faces parallel). The criterion of a successful detonation transfer is that the accepting end-booster must initiate its end coupler which in turn must initiate the MDF within the end coupler. A test arrangement was made and is shown in Fig. 11. Aluminum witness plates were used to sense the detonation of the final MDF. In this experiment, Fig. 11, the detonation transfer is accomplished over an air gap between base charges (no metal cups or sealing discs). We would expect, as has been shown in reference 9 as well as in other work, that in a final component design a thin end closure on the charge would break up into fragments, aiding in detonation transfer.

To obtain maximum drive from the end coupler, the diameter of the output end of the end coupler was made only a few mils smaller than the diameter of the end-booster base charge (Fig. 12). The end-booster charge was 1 grain (65 mgs.) of HNS-I or DIPAM, as desired. The results in Fig. 13 show at least a 6% difference between HNS-I and DIPAM on the basis of output alone.

McDonnell Aircraft Corp has shown[7] that either DIPAM or HNS-I, in the gilding-metal end-booster design, will detonate sympathetically in the end-to-end arrangement over distances in excess of 2-3/4 inches. The data in Fig. 14 summarize our studies.

END BOOSTER FOR THE F-111 AIRCRAFT

The F-111 aircraft is of two versions: F-111A for the Air Force and F-111B for the Navy. The same basic severance and ejection system will be used in both aircraft. The McDonnell Aircraft Corp. is responsible for the pilot escape system. Each MDF or FLSC line of the escape system terminates in an explosive component or in an end coupler/end booster which is then assembled into a junction box (Fig. 15). All of these terminating components must be highly reliable to insure a reliable escape system even though the system is replete with redundant paths. The necessity for the redundant paths arises from the tactical use of the aircraft.

At the outset of the study on end boosters, we used a high speed framing camera to observe the detonation progress into and back out of an end-booster of the Ensign-Bickford Co. design, (Fig. 16). Frame 1 shows the expansion of the MDF due to the detonation wave traveling in from the left of the frame. The first break-out is seen in frame 4. The luminescent gilding-metal fragments appear in frame 6 on the original films, and are easily visible by the 8th frame emerging from the cloud of reaction products. Using these photographs together with data from other camera and hardware studies, the McDonnell Aircraft Corp.[8,9] has been able to predict the detonation transfer reliability of end boosters for use in the F-111 aircraft system.

Explosive Technology, Inc., was awarded a contract by MAC for improving and engineering the NOL design of the end coupler for the F-111 system. They studied three variants of the NOL design (Figures 17, 18, and 19). The output energy was low for the first two types (Figures 17 and 18). The final first flight design selected was the one shown in Fig. 19 which has essentially the same explosive configurations as the NOL design (Fig. 12).

In order to determine the quality of the end booster production, McDonnell Aircraft invented an energy sensor (Fig.20) which measures end booster output in inch-lbs. This is a piston/honeycomb-crush type of apparatus which depends upon the property of the honeycomb material - that is it takes a constant load to crush it; hence the measurement of the distance that a piston penetrates into the honeycomb multiplied by the characteristic crushing force gives energy measurement in terms of work, where work = force times distance. The development of this energy-sensor technique is described in reference 10. A comparison, using the energy sensor, of the output from the NOL end booster and the version engineered by Explosive Technology shows the output energies to be of the same order of magnitude (Table 1). Note also that the choice of explosive used in the end booster and the choice of cone angle in the end coupler doesn't make much difference in the average of the outputs. But the variability as measured by the standard deviation is considerably less when HNS-I is used as the explosive in the end-booster.

A typical junction box donor/acceptor arrangement is shown in Fig. 21 where a detonation in any one of the four pieces of MDF will initiate its associated end booster which will then countermine the remaining end boosters. This is one of the systems used in the F-111 aircraft. Note in the escape system schematic (Fig. 15) that by using these junction boxes complex explosive circuits can be built up to incorporate time delays, explosive bolts, actuators, and other devices.

LOW TEMPERATURE TESTING OF MDF

The effect of low temperatures on the heat resistant MDF is important from the end application standpoint. We are now collecting data (Figures 22 and 23) on this effect. In Fig. 22 one length each of DIPAM and HNS-MDF was subjected to a liquid nitrogen temperature (-320°F) and initiated. Both samples detonated completely when initiated by a #6 blasting cap. Note that the point of initiation was near ambient temperature.

D'Autriche tests[11] were run on two 5-ft lengths of MDF (each from different DIPAM samples) to see if the detonation velocity might be changed markedly at very low temperatures. The mid-point of the MDF piece was located and placed on a scribed line on an aluminum witness plate. As can be seen in Fig. 23, a 12-inch length of one leg of the MDF was held at -320°F while the rest of the MDF was maintained near ambient temperature. Since both ends of the MDF were initiated simultaneously it would be expected that the detonation fronts from each end would arrive simultaneously and collide at the midpoint if the transit time (detonation velocity) is the same in each leg. Wherever the approaching detonation fronts collide a characteristic mark is made on the aluminum witness plate. The displacement, d, of the D'Autriche mark from the midpoint is used to compute the velocity ratio by the equation

$$\frac{Vc}{Va} = \frac{d_t + 2d}{d_t}$$

where Vc is the velocity in the chilled section
Va is the velocity at ambient temperature
d_t is the length of the chilled section — 305 mm

d is the displacement of the D'Autriche mark taken as positive if the displacement is away from the chilled section.

From Table 2 it can be seen that if there were any change in the detonation velocity because of the low temperature environment it must have been less than 5% and, in the particular experiment, was not detected. This experiment shows also that an MDF (Lot #6369)[18] made of large particle size DIPAM (Fig. 24) is not affected by the low temperature of the test.

CONCLUSIONS AND RECOMMENDATIONS

From the results of this program, it can be concluded that:

a. HNS-I should be used to transfer detonation from small core load MDF to an end booster.

b. HNS-I explosive will initiate DIPAM and HNS-I in an end booster.

c. Both the 20° and 30° tapered section of the end coupler are satisfactory for build-up of the detonation front using HNS-I explosive.

d. The 20°-end coupler design allows more time for build-up of detonation with the HNS-I material and, therefore, may be the more reliable design.

e. DIPAM and the standard HNS-R are not recommended for end coupler application.

f. Low temperatures (-320°F) for a short length of time do not affect the detonation velocity of the low core load DIPAM-MDF and the large core load HNS-R/MDF.

On the basis of the above work and in view of the new process of producing HNS-I from TNT[13], it is recommended that this material be explored for possible use in leads and boosters as a pure explosive or a plastic bonded explosive (PBX).

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TABLE 1

ENERGY SENSOR (OUTPUT) DATA FOR NOL AND ETI END BOOSTERS
Values in Inch-Pounds

	20° Taper Cone			30° Taper Cone	
	DIPAM	HNS-I		DIPAM	HNS-I
NOL End Booster with 2.1 gr/ft DIPAM-MDF (Fig. 12)	281	325		294	334
	385	205		294	310
	161	381		388	355
	354			242	377
	$\bar{x}$=295	$\bar{x}$=304		$\bar{x}$=305	$\bar{x}$=344
	s=100	s= 90		s= 61	s= 29
ETI Booster, Style 3, with 3.5 gr/ft DIPAM-MDF (Fig.19)		320	276	286	
		340	300	310	
		314	252	280	
		279	420	264	
		316	390	336	
		314	348	350	
		426	338	402	
		301	375	364	
		290		331	
		$\bar{x}$=329	$\bar{x}$=337	$\bar{x}$=325	
		s= 48	s= 54	s=125	

NOTE: $\bar{x}$ = average, s = standard deviation.

TABLE 2

RESULTS OF D'AUTRICHE EXPERIMENTS FOR MEASURING
THE DETONATION VELOCITY OF MDF AT VERY LOW TEMPERATURES

Identification of MDF	Lot # 6369	Lot # 6368
Identification of DIPAM	AC 328-45	X-452
Core Load (gr/ft)	2.67	2.48
Displacement of D'Autriche Mark (mm)	-7(toward chilled section)	+4(away from chilled section)
Average Ambient Temperature Detonation Velocity(mm/μsec)	6.24	5.98
Detonation Velocity in Chilled Section (mm/μsec)	5.95	6.14
Observed Variability in Detonation Velocity Due to Samping Error (mm/μsec)	±0.09	±0.22
Error in Detonation Velocity Due to an Inaccuracy of 5 mm in Locating Center of 60 inch Length of MDF (mm/μsec)	±0.2	±0.2

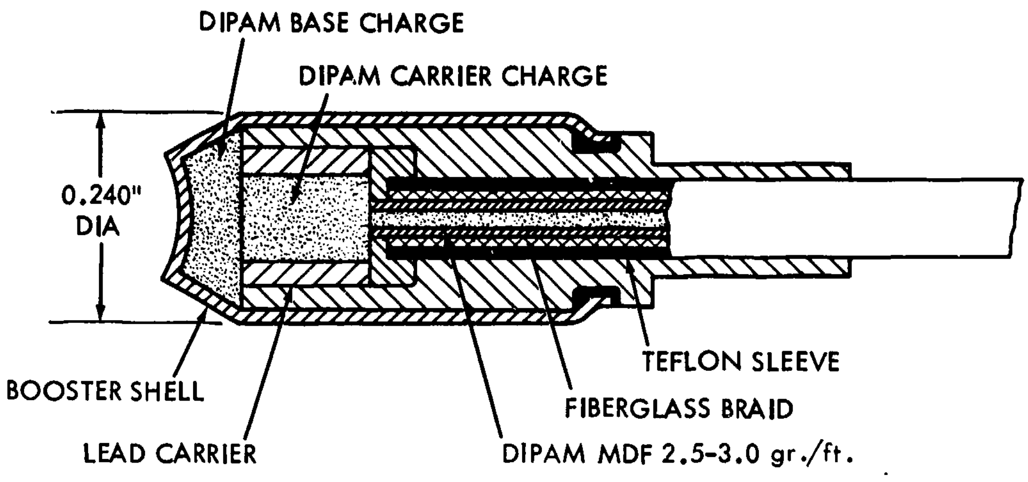


FIG.1 THE ENSIGN-BICKFORD CO. END BOOSTER DESIGN

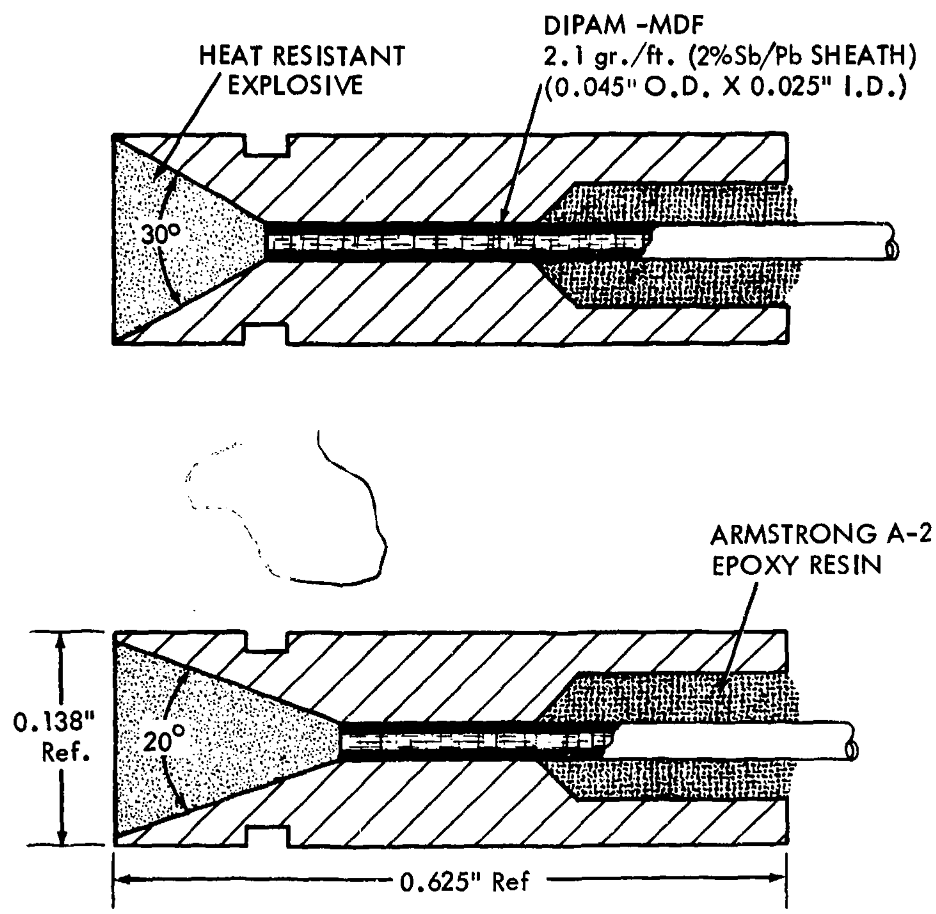


FIG.2 NOL END COUPLER DESIGNS

FIG.3 PHOTOMICROGRAPH OF DIPAM.BULK DENSITY<0.2 g/cc
(NOL SAMPLE NO. Z-510)

FIG.4 PHOTOMICROGRAPH OF DIPAM.BULK DENSITY<0.2 g/cc
(NOL SAMPLE NO. X-428)

FIG.5 PHOTOMICROGRAPH OF DIPAM. BULK DENSITY < 0.5 g/cc
(NOL SAMPLE NO. X-453)

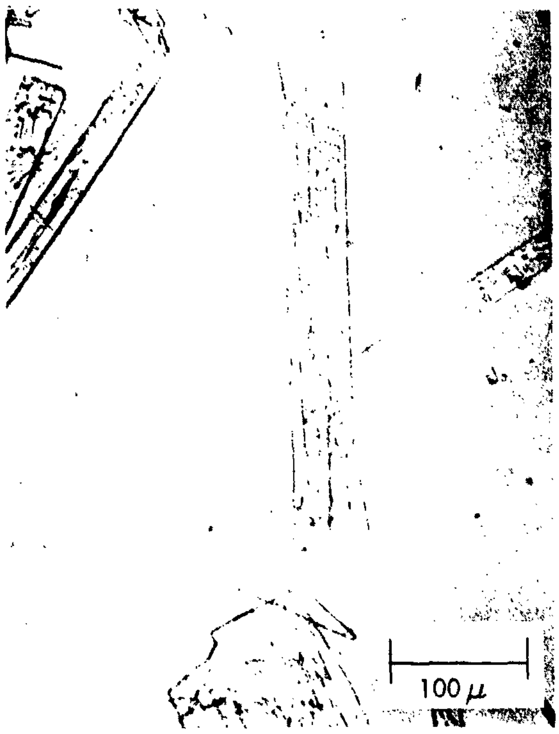


FIG. 6 PHOTOMICROGRAPH OF HNS-R, BULK DENSITY < 0.26 g/cc
(NOL SAMPLE NO. X-420)

FIG. 7 PHOTOMICROGRAPH OF HNS-I. BULK DENSITY <0.2 g/cc
(NOL SAMPLE NO. X-455)

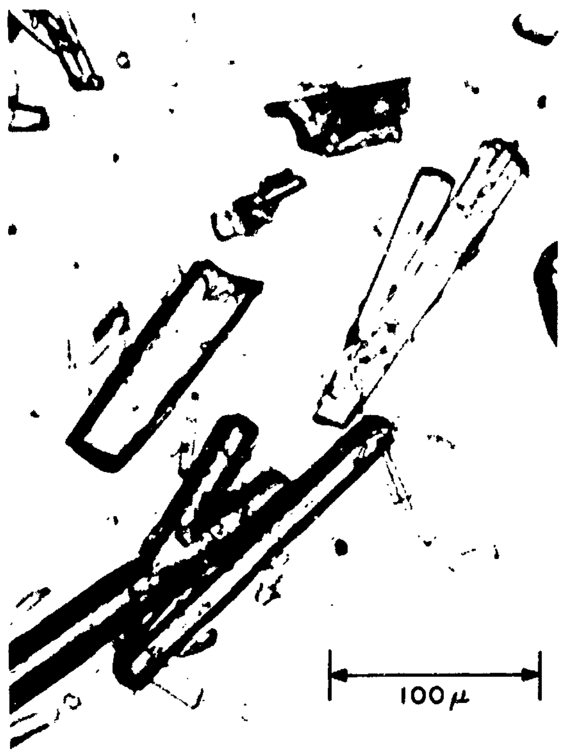
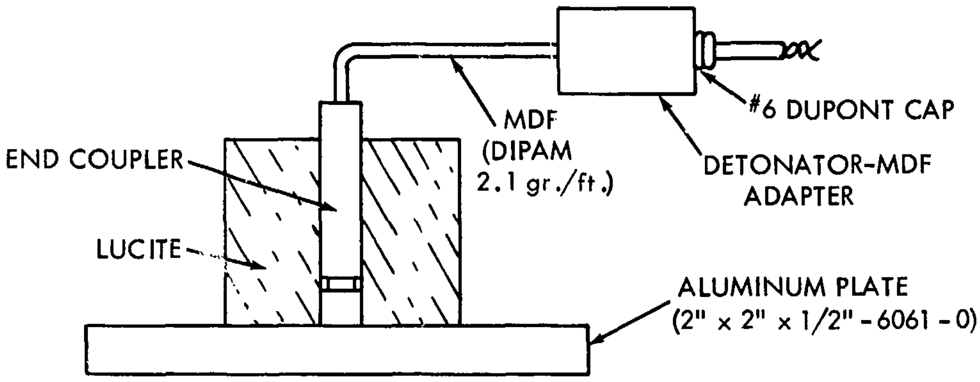


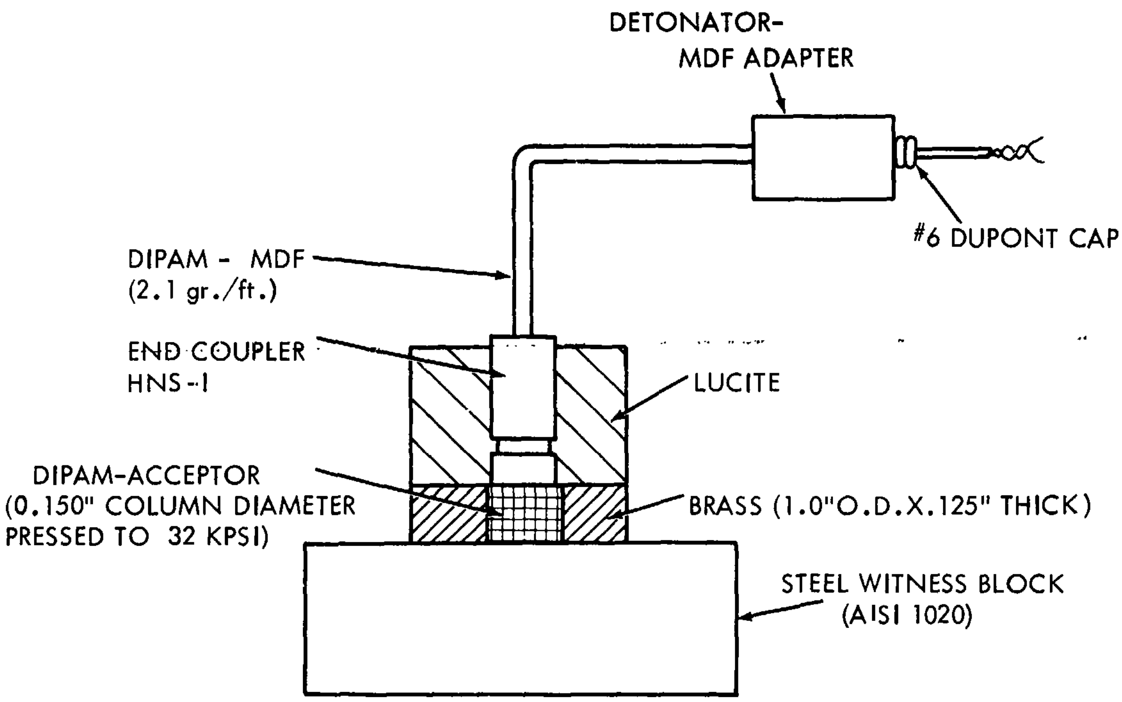
FIG. 8 PHOTOMICROGRAPH OF NONA.
BULK DENSITY 0.7 g/cc
(NOL SAMPLE NO. X-424)



DENT OUTPUT (MILS) AT PRESSURE OF

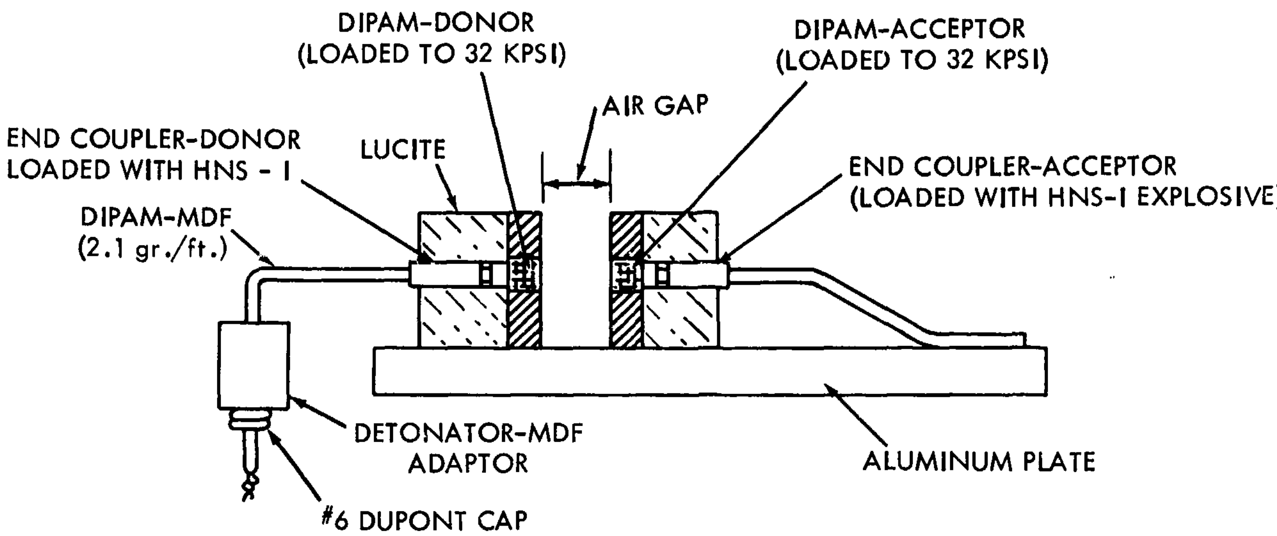
EXPLOSIVE	BULK DENSITY	CONE ANGLE	4K PSI	8K PSI	16K PSI	32K PSI	64K PSI
DIPAM (Z-510) (FIG.3)	LESS THAN 0.2	30°				2-FAILURES	2-FAILURES
		20°					
DIPAM (X-428) (FIG.4)	0.2	30°			2-FAILURES	2-FAILURES	49,69
		20°			FAILURE	FAILURE	FAILURE
DIPAM (X-452)	0.36	30°				2-FAILURES	2-FAILURES
		20°					
DIPAM (X-453) (FIG.5)	0.5	30°				2-FAILURES	2-FAILURES
		20°					
HNS-R (X-420) (FIG.6)	0.26	30°					
		20°			15,29	63,65	64
HNS-I (X-455) (FIG.7)	0.2	30°	24	33,46	27,47	55,58	
		20°	43,46	51,56	50,57	61	
NONA (X-424) (FIG.8)	0.7	30°					
		20°			18		

FIG.9 TEST CONFIGURATION AND RESULTS OF OUTPUT FROM DIPAM, HNS,AND NONA END COUPLERS



END COUPLER LOADING PRESSURE KPSI	ACCEPTOR STEEL DENT OUTPUT (MILS)	
	30° CONE TAPER	20° CONE TAPER
8	23	25
16	21	25
32	24	24

FIG. 10 DIPAM ACCEPTOR INITIATION FROM END COUPLER



END COUPLER DONOR LOADING PRESSURE (PSI)	CONE TAPER (DEGREES)	AIR GAP (MILS)	CONE TAPER (DEGREES)	END COUPLER ACCEPTOR LOADING PRESSURE (PSI)	RESULTS
8,000	20	40	20	8,000	COMPLETE INITIATION TRANSFER
16,000	20	40	30	16,000	"
32,000	30	40	20	8,000	"
16,000	20	0	20	16,000	"
32,000	20	160	20	32,000	DIPAM-ACCEPTOR FAILURE

FIG.11 INITIATION OF ACCEPTOR BY DONOR THRU AN AIR GAP

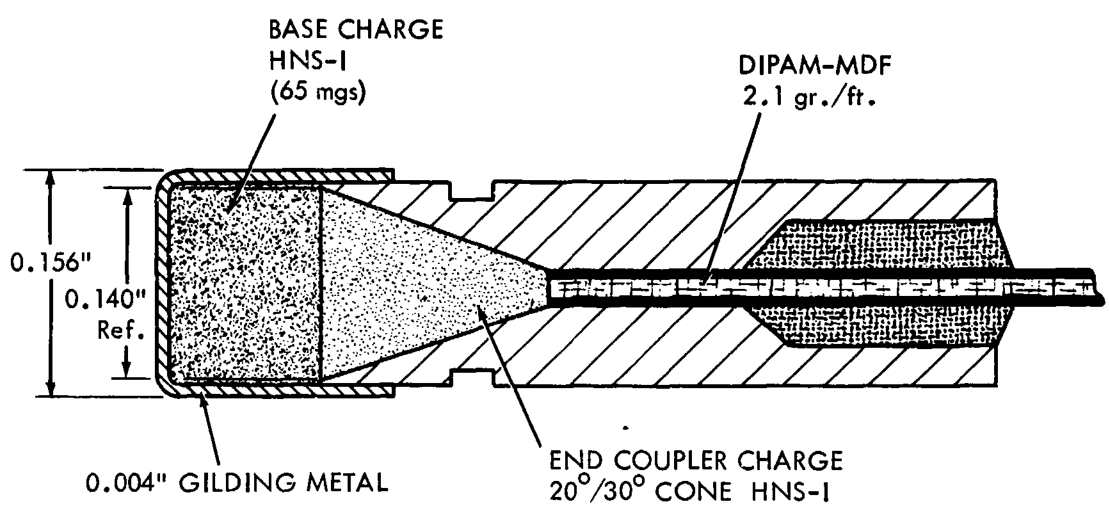
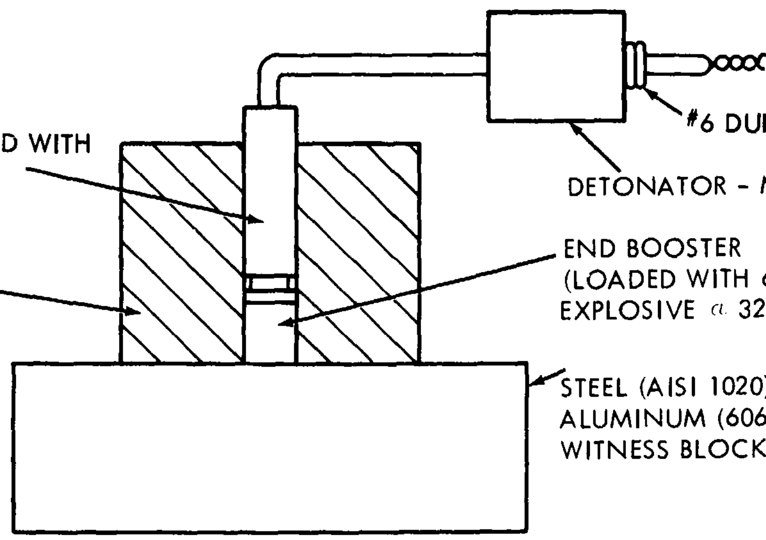
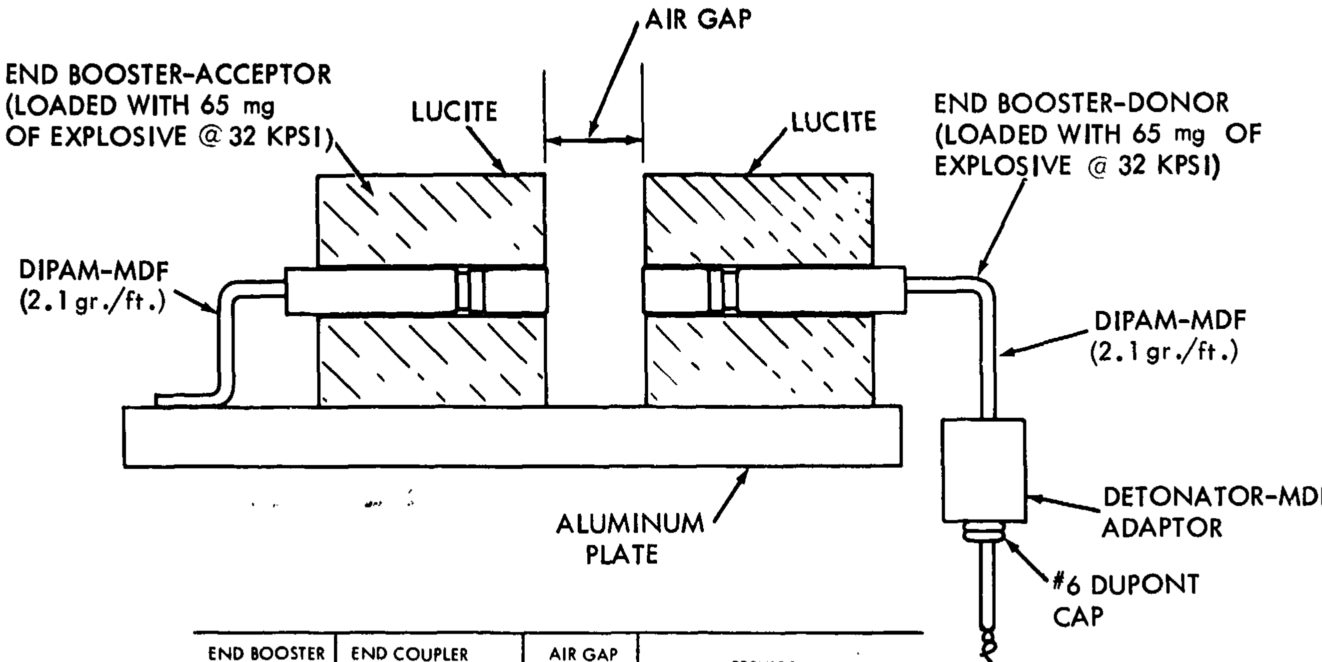


FIG. 12 THE NOL END BOOSTER DESIGN



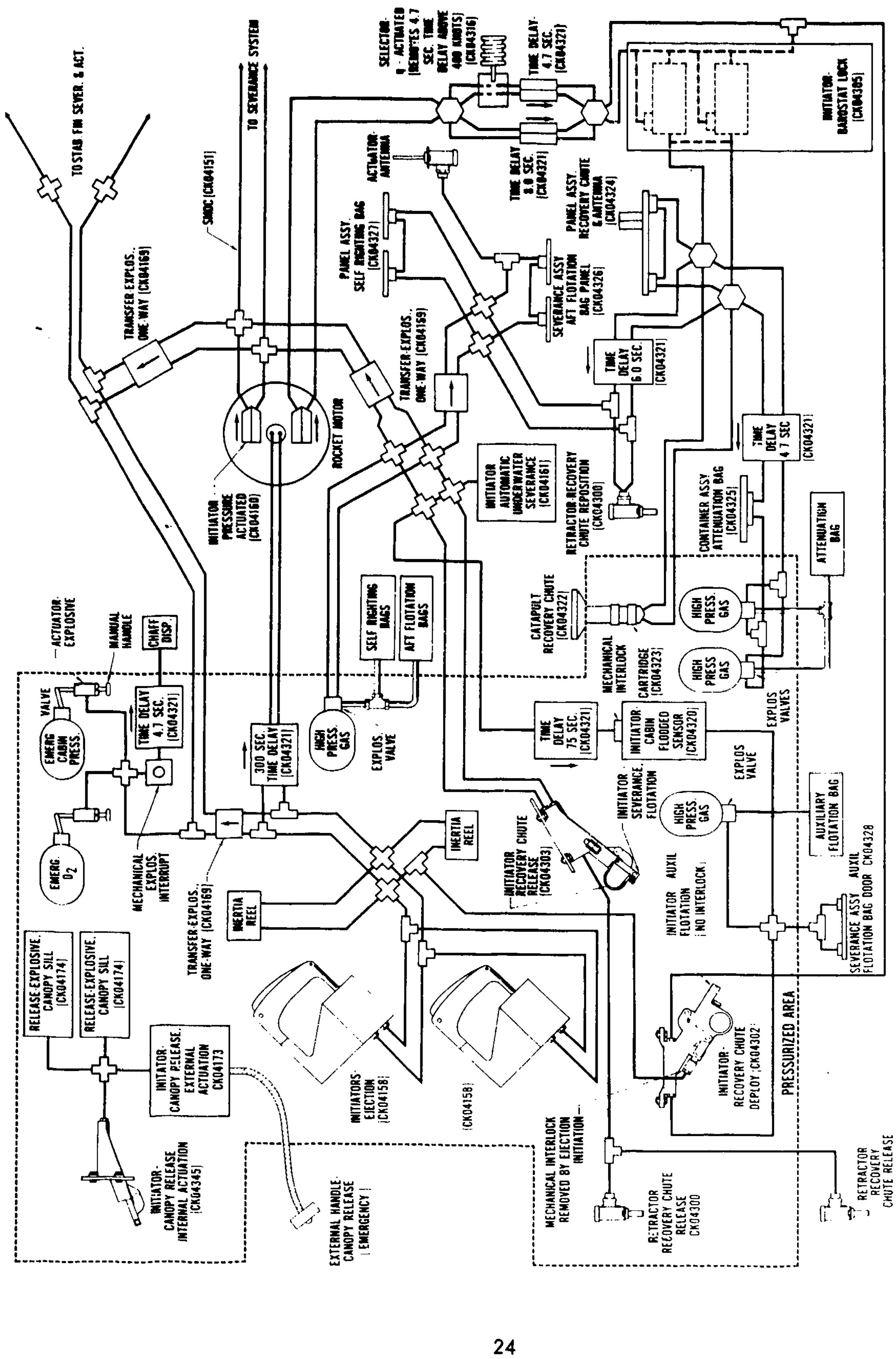
END-BOOSTER EXPLOSIVE	OUTPUT DENT (MILS)		
	LUCITE HOLDER		STEEL HOLDER
	ALUMINUM WITNESS BLOCK	STEEL WITNESS BLOCK	STEEL WITNESS BLOCK
DIPAM	80	12	NO TESTS
HNS - I	75, 72, 73	10, 12, 12, 11	20, 20, 19 19, 19, 19

FIG. 13 END BOOSTER OUTPUT TEST



END BOOSTER EXPLOSIVE	END COUPLER CONE (DEGREES)	AIR GAP (INCHES)	RESULTS
DIPAM	30	0.250	COMPLETE INITIATION TRANSFER
"	30	0.500	"
"	30	0.750	"
"	30	1.000	"
"	30	1.250	"
DIPAM	20	2.000	"
"	20	2.500	"
"	20	2.750	"
HNS-I	30	0.250	COMPLETE INITIATION TRANSFER
"	30	0.500	"
"	30	0.650	"
"	30	0.708	"
"	30	0.794	"
"	30	0.891	"
"	30	1.413	"
"	30	2.512	"
"	30	2.610	"
"	30	2.888	COMPLETE INITIATION TRANSFER

FIG.14 END BOOSTER AIR GAP TESTS



—— DIPAM - MDF AND/OR FLSC
END BOOSTER JUNCTION BOXES

FIG.15 F-111 ESCAPE SYSTEM SCHEMATIC (McDONNELL AIRCRAFT CORPORATION)

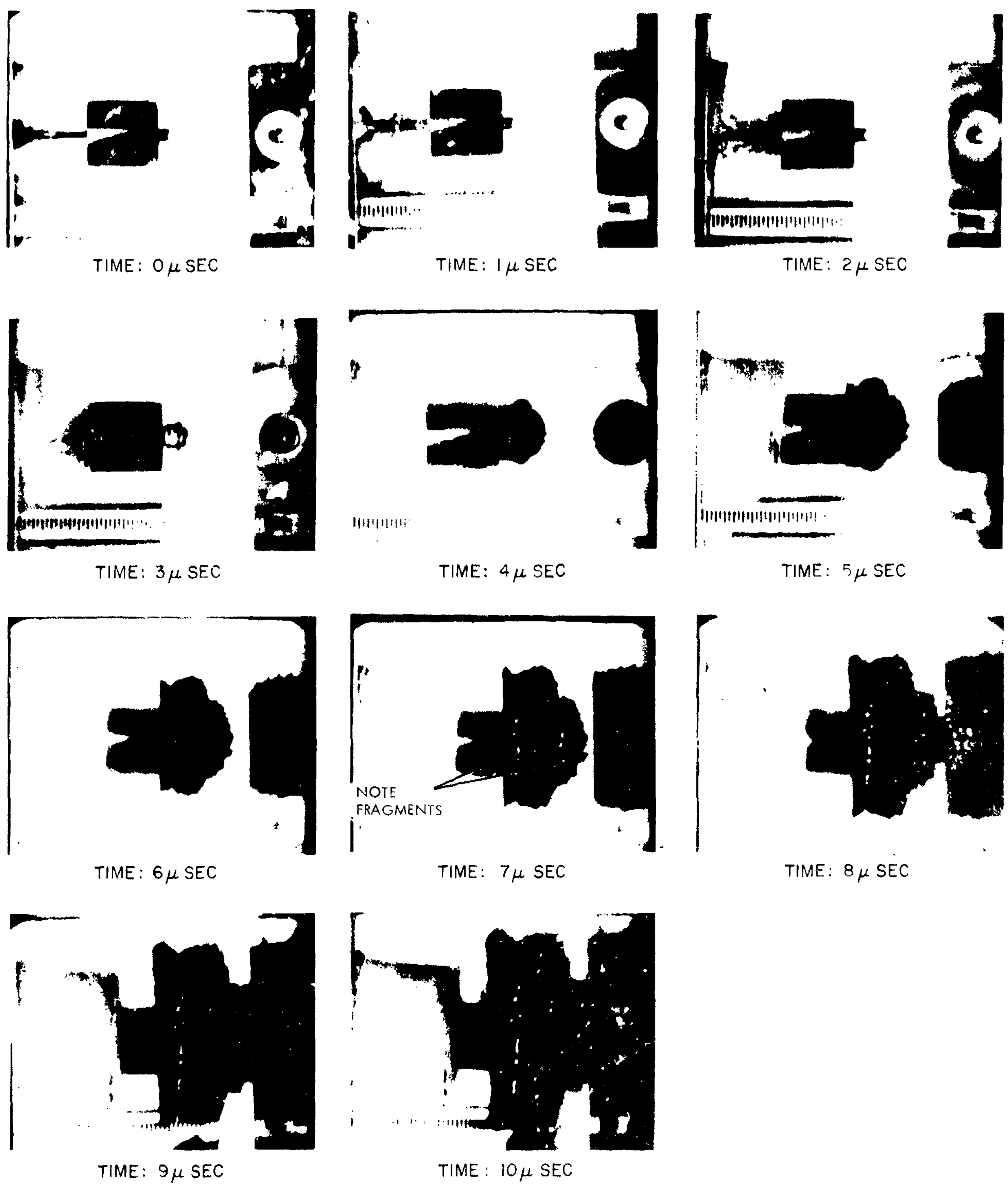


FIG.16 HIGH SPEED CAMERA SHOT OF THE ENSIGN-BICKFORD CO. END BOOSTER (SJ-143)

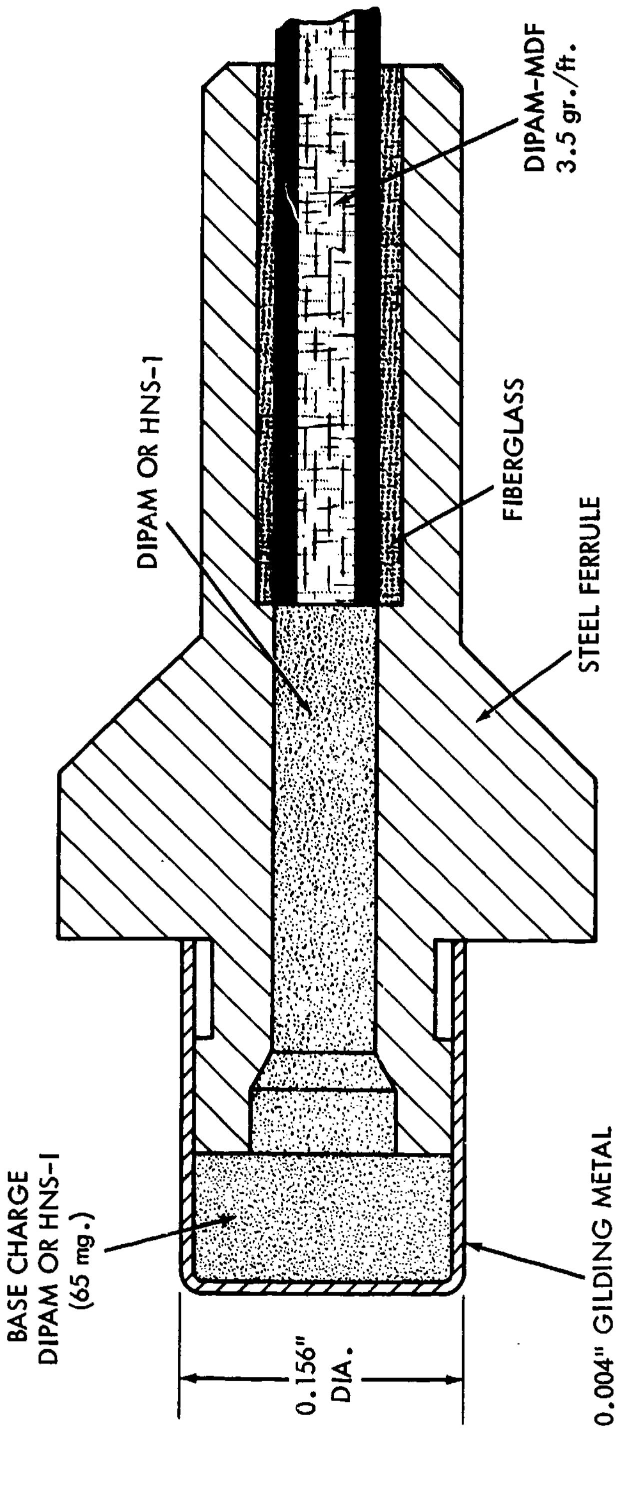


FIG. 17 END BOOSTER DESIGN CONFIGURATION #8 (EXPLOSIVE TECHNOLOGY, INC.)

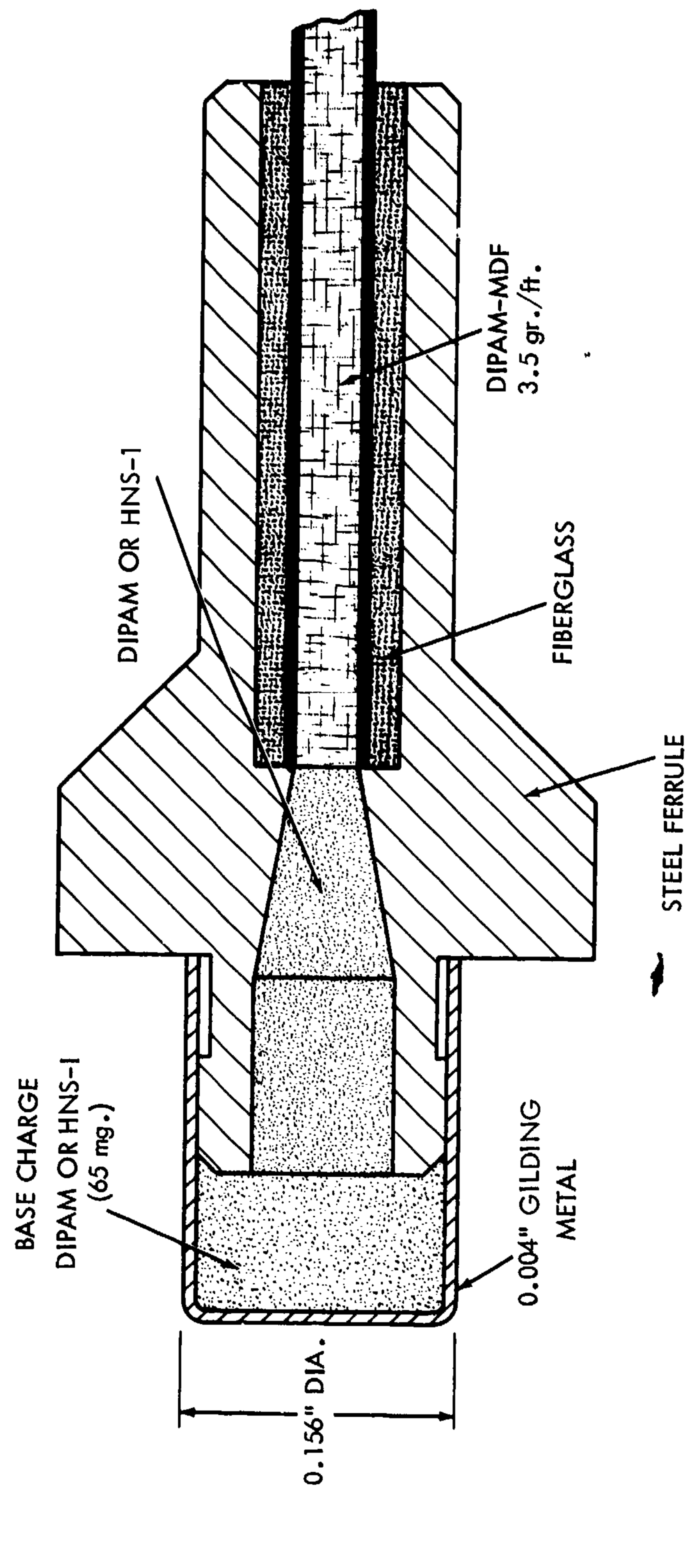


FIG. 18 END BOOSTER DESIGN CONFIGURATION #3 (EXPLOSIVE TECHNOLOGY, INC.)

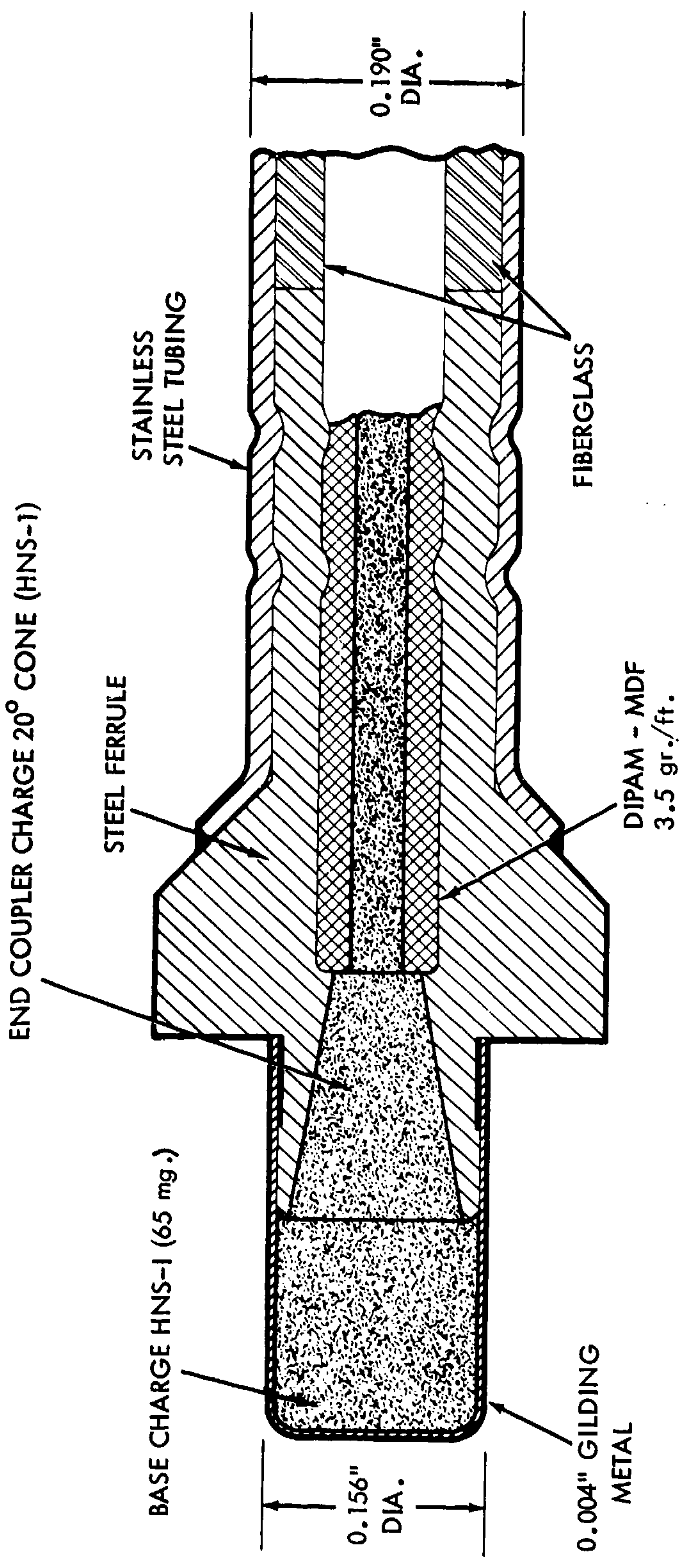


FIG. 19 PRELIMINARY END BOOSTER DESIGN FOR THE F-111 AIRCRAFT
(EXPLOSIVE TECHNOLOGY, INC.)

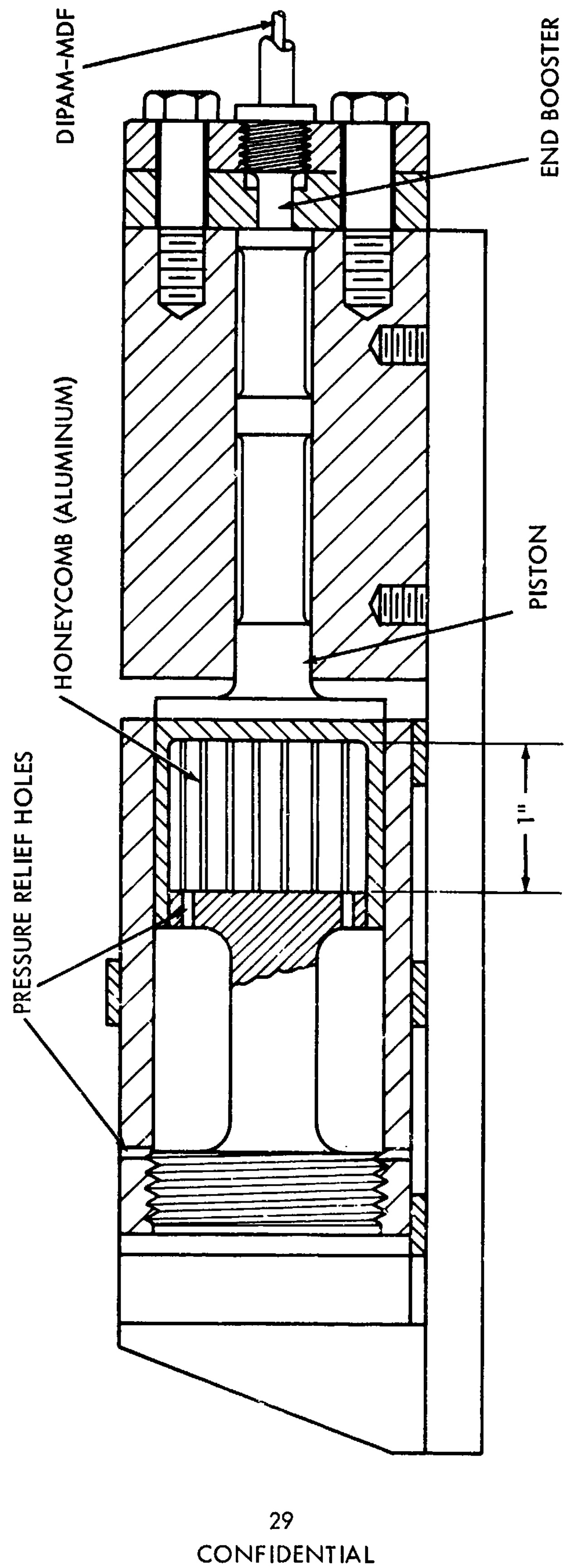


FIG. 20 ENERGY SENSOR 12 K - 026 - 07 (McDONNELL AIRCRAFT CORP.)

SCALE 1:1

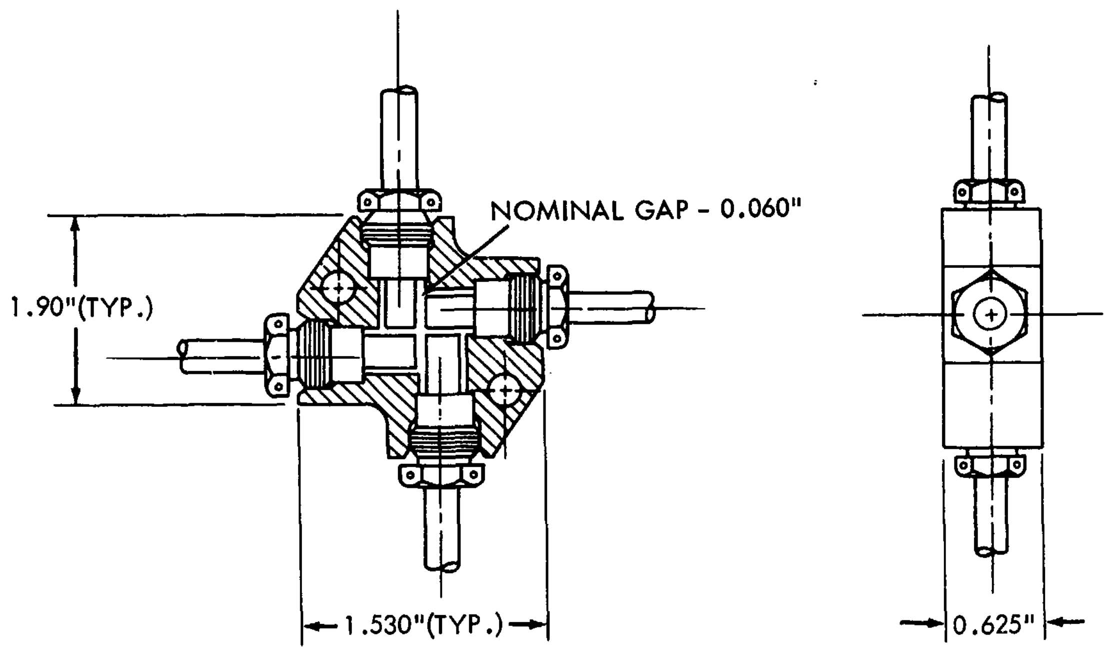
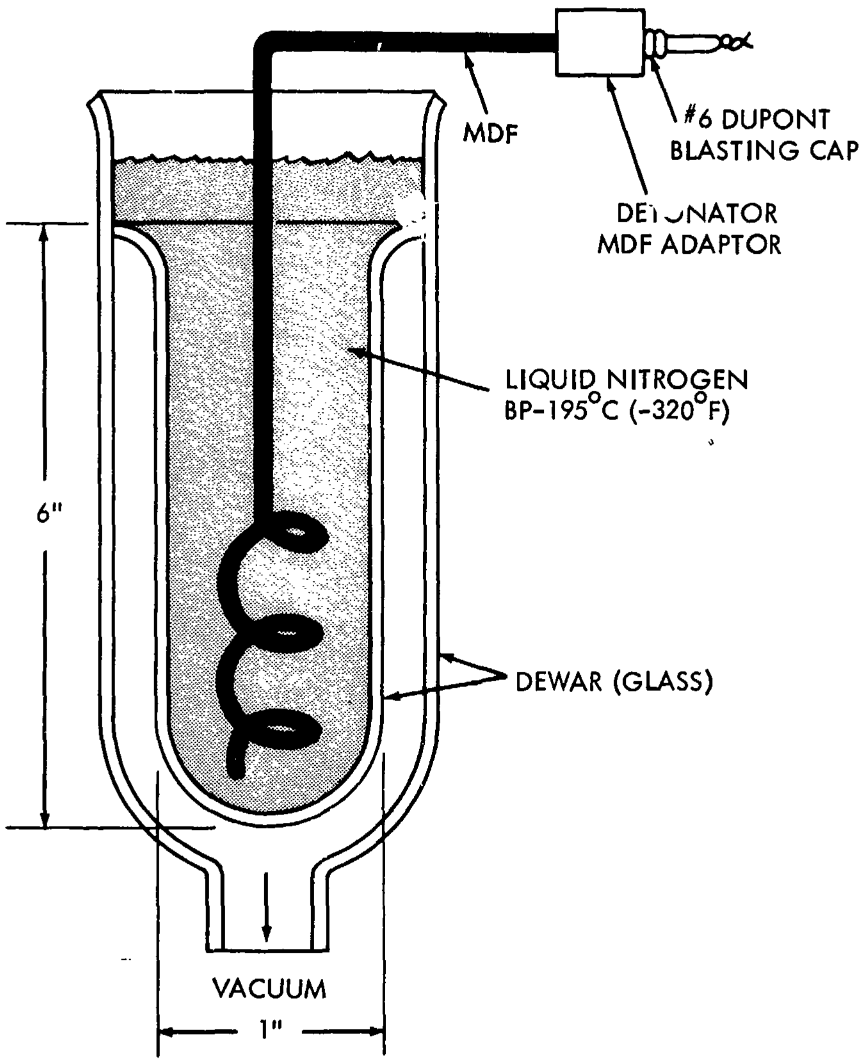


FIG. 21 CROSS CONNECTOR WITH END BOOSTERS INSTALLED
(McDONNELL AIRCRAFT CORP.)



MDF IDENTIFICATION	EXPOSURE TIME (MIN)	RESULTS
DIPAM 2.1 gr./ft. (Z-486)	8	COMPLETE DETONATION
HNS-R 11.4 gr./ft. Z-448	10	COMPLETE DETONATION

FIG.22 MDF LOW TEMPERATURE TEST

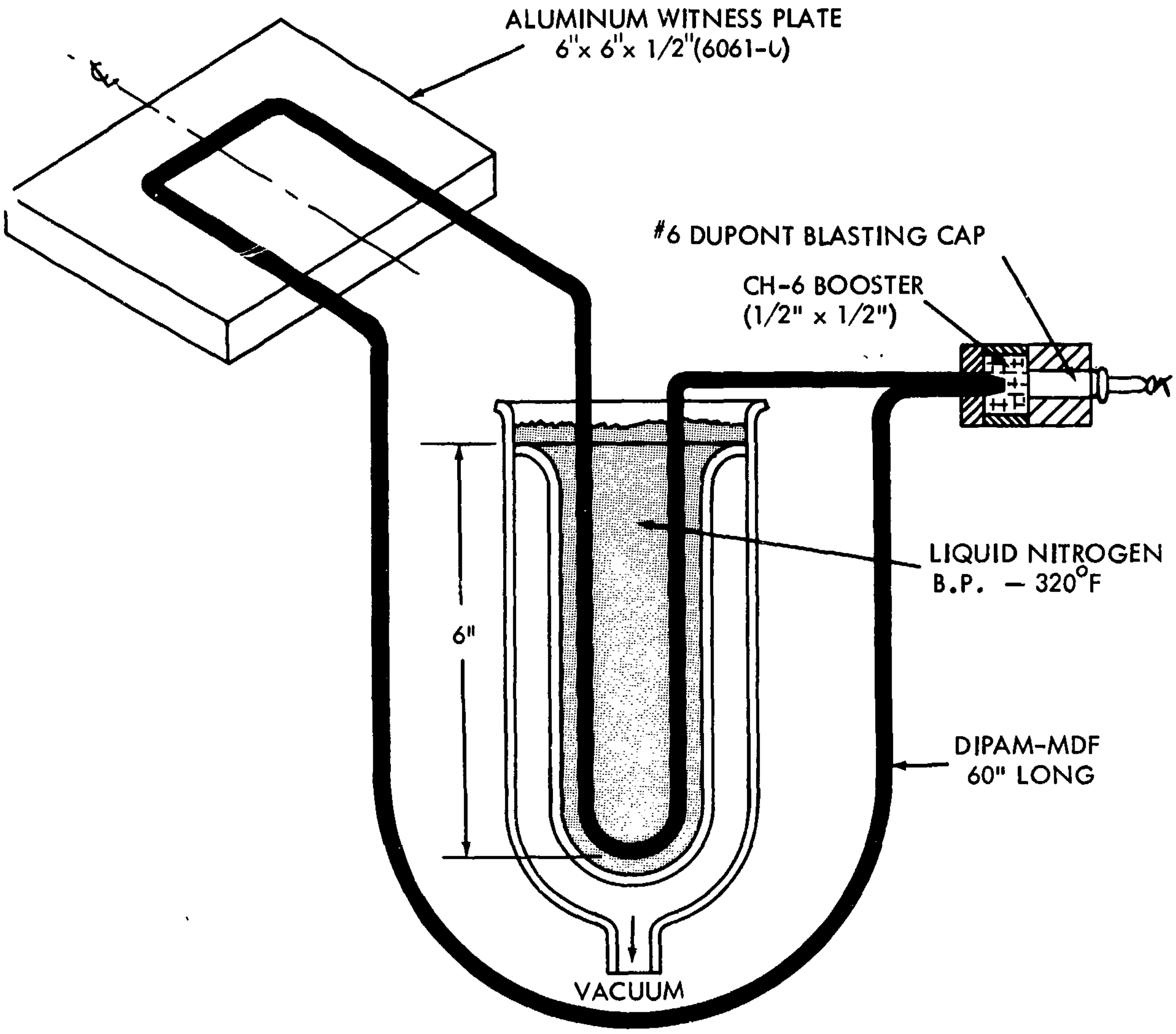


FIG.23 D'AUTRICHE TEST WITH MDF SECTION AT LOW TEMPERATURE

FIG.24 PHOTOMICROGRAPH OF DIPAM PRECIPITATED FROM DIOXANE & TOLUENE

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Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Naval Ordnance Laboratory, White Oak	2a. REPORT SECURITY CLASSIFICATION CONFIDENTIAL 2b GROUP 4

3. REPORT TITLE

End Booster for Heat Resistant Mild Detonating Fuse (U)

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (Last name, first name, initial)

Kilmer, E. Eugene

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Bureau of Naval Weapons

13. ABSTRACT

A heat resistant explosive system containing mild detonating fuse (MDF) and/or flexible linear shaped charge (FLSC) is not complete without an end booster to transfer detonation into and/or out of the system. The experimental work, leading to a successful series of designs, utilizing and exploiting the unique properties of a new explosive, is given in this report along with the design of a typical end booster. (U)

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Boosters, mild detonating fuse Couplers, mild detonating fuse Fuses, mild detonating Fuses, explosives Missiles Crew Module, aircraft Aircraft, F-111 Space vehicle - GEMINI						

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Naval Ordnance Laboratory, White Oak, Md.
(NOL technical report 65-98)
END BOOSTER FOR HEAT RESISTANT MILD DETONATING FUSE (U), by E. Eugene Kilmer. 6 April 1966. 32p. illus., tables. NOL task 321.

CONFIDENTIAL

A heat resistant explosive system containing mild detonating fuse (MDF) and/or flexible linear shaped charge (FLSC) is not complete without an end booster to transfer detonation into and/or out of the system. The experimental work, leading to a successful series of designs, utilizing and exploiting the unique properties of a new explosive, is given in this report along with the design of a typical end booster.

1. Fuses, Mild detonating
2. Charges, Shaped
I. Title
II. Kilmer, E. Eugene
III. Project

Abstract card is unclassified.

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Downing, Lawrence

From: Downing, Lawrence
Sent: Friday, March 16, 2001 9:37 AM
To: 'Garfield Catherine DLVA'
Subject: RE: de-classification of NOLTR-65-98

Cathy,

The update on EDMS was completed on 16 March 2001. This should show the corrections on the morning of 22 March 2001. Larry

-----Original Message-----
From: Downing, Lawrence
Sent: Friday, March 02, 2001 1:07 PM
To: 'Garfield Catherine DLVA'
Subject: RE: de-classification of NOLTR-65-98

Cathy,
I received the fax and will make the update. Please note that I must recall the document and this takes a couple of days. Should be completed and updated Wed night (7 March 01). I will forward an e-mail to you at that time. Larry Downing, 703-767-0011.

-----Original Message-----
From: Garfield Catherine DLVA [mailto:GarfieldC@NSWC.NAVY.MIL]
Sent: Friday, March 02, 2001 12:48 PM
To: 'ldowning@dtic.mil'
Subject: de-classification of NOLTR-65-98

Larry,
I received your phone call in response to my inquiry regarding AD-372 863 / XAG, an old NOLTR. I have faxed to you the letter justifying the downgrade of this document. I hope you can retreive it from you fax machine since I forgot to put your name on it and didn't send a cover sheet!! Sorry. Please advise me if I need to resend it.
Thank you for your attention to this request for downgrading the document.
Cathy

Catherine Garfield
Reference Librarian
Technical Information Division / B60
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Dahlgren, VA 22448
DSN 249-2631

2 MAR 2001

NAVAL SURFACE WEAPONS CENTER
WHITE OAK LABORATORY
SILVER SPRING, MARYLAND 20910

To all holders of NOLTR 65-98 Change 2
Title: End Booster for Heat Resistant Mild Detonating Fuse 17 Aug 1979

Approved by Commander, NAVSURFWPNCEN 1 page(s)

Julius W. Enig
JULIUS W. ENIG
By direction

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Delete: p.7 - All References

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